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December 31, 1998

Project 5838

Mr. Lonnie Monaco
Naval Facilities Engineering Command (NAVFACENGCOM)
Northern Division
Environmental Contracts Branch, Mailstop #82
10 Industrial Highway
Lester, Pennsylvania 19113

Reference: CLEAN Contract No. N642472-90-D-1298
Contract Task Order (CTO) No. 225

Subject: Responses to Comments for Groundwater Monitoring Reports
Former Naval Air Warfare Center (NAWC) Warminster, Pennsylvania

Dear Mr. Monaco:

As requested, Tetra Tech NUS (TtNUS) has responded to comments regarding the Summary Report for Areas A and D Groundwater Monitoring (February 1998) (Enclosure 1) and the Round 10 Perimeter Monitoring Report (September 1998) (Enclosure 2). The enclosures to this letter provide these responses.

Based on these responses, TtNUS currently does not plan to provide revised versions of these reports. This comment response letter will be added to the Administrative Record File for the base along with copies of the respective reports.

Please contact me if you have any questions or comments.

Sincerely,

Neil Teamerson

Neil Teamerson
Project Manager

ANT/ejc

Enclosures

c: Thomas Ames (NAVFACENGCOM)
Timothy McEntee (NAVCFACENGCOM)
Kathryn Davies (EPA Region III)
Darius Ostrauskas (EPA Region III)
April Flipse (PADEP)
David Fennimore (Earth Data)
Anthony Sauder (Pennoni)
Ronald Sloto (USGS)
Jeffrey Orient (Tetra Tech NUS)
Garth Glenn (Tetra Tech NUS) (without enclosures)

ENCLOSURE 1

RESPONSES TO COMMENTS
SUMMARY REPORT FOR AREAS A AND D GROUNDWATER MONITORING
December 31, 1998

EPA Region III Comments (undated)

The report suggests that off-site sources of contamination are responsible for the pattern of 1,1,1-TCA found in the vicinity of Area A and PCE in the vicinity of the shallow well HN-52S. From the distribution of 1. 1,1-TCA and the associated chemicals, 1,1-DCA and 1,1-DCE, found predominantly in shallow wells HN-16 (not well cluster HN-66 as stated on page 2-35) and HN-52 and Well No. 93, it appears that an off-site source for these contaminants is probable. ***Response:*** *None required.*

Section 1.3.2. Methodology: It was stated here that the majority of monitoring wells were sampled using a low-flow purging and sampling technique. Please explain the following: why this sampling technique was chosen, how well construction details and borehole logs were evaluated for the appropriate placement of the pump intake, why the method was not uniformly applied to all wells, and why stabilization criteria did not include redox and dissolved oxygen. Additionally, the field data supporting purging and sampling stabilization should be provided in the report. It should be further noted that tile EPA Region III directive provided has been modified with no notation or reference. It is not clear that the purging and sampling methodology was appropriately utilized during this sampling event and that the resultant analyses may not be representative of site conditions. ***Response:*** *The low-flow purging and sampling technique was specified in the scope of work for comprehensive Area A and Area D groundwater monitoring (Brown & Root Environmental, October 30, 1997). Some monitoring wells, particularly deep, open boreholes, were not sampled using this technique, because it was too time-consuming a task for those wells. Well construction details and yield rates were considered in placing the submersible pump and purging each well in order to collect a representative groundwater sample.*

Redox and dissolved oxygen parameters were not recorded during purging. Based on the Navy's experience in groundwater sampling at the base, turbidity, temperature, and specific conductivity measurements have usually been the best indicator that wells have stabilized before sampling. If necessary, the Navy will provide under separate cover the appropriate field data supporting the well sampling program used during comprehensive groundwater monitoring.

The EPA Region III directive for low flow purging and sampling (dated August 1994) was modified by the Navy's consultant to account for those wells where three well volumes could not be purged within 1 hour.

Only a few deep, primarily open borehole, monitoring wells and dry wells fell into this category. These wells were not appropriate candidates for the low-flow technique, given their well construction details or yields. To avoid a combination of several different purging and sampling approaches, the directive was modified to account for what actually occurred in the field.

The Navy believes that the sampling event and resultant laboratory analyses are representative of site conditions regarding groundwater quality. A variety of sampling procedures have been used since the early 1980s to collect groundwater samples at the base. The analytical results generated as part of the December 1997 sampling event are not significantly different in relative terms than previous sampling events. For example, samples from wells previously containing elevated levels of VOCs revealed comparable levels as part of the December 1997 sampling event. As such, it is the Navy's position that the laboratory data are representative of those groundwater quality conditions that existed in December 1997.

Section 2.1: The well screen intervals should either be added to Table 2-1 or Table B-1 should also be referenced here in the text. ***Response:*** *Table B-1 could have been referenced to provide information regarding the monitored interval of the appropriate Area A and Area D wells.*

Section 2.2. Page 2-6: The statements here regarding significant water level fluctuations in areas west of the main building are contradictory to those presented on pages 4-7,4-9 and 4-12 of the draft Area D Supply Well and Water-Level Study Report. ***Response:*** *The Summary Report and Area D Supply Well and Water-Level Study Report both reflect responses to pumping in the intermediate depth water-bearing zone and little to no effect on shallow groundwater west of the main building complex at the base. A discussion of the water-level elevation measured in well HN-56I during December 1997 could have been added to the Summary Report to clarify this observation.*

The southern-most water level contours depicted on Figure 2-3 could also be drawn to have a much stronger western component of flow. ***Response:*** *The Navy neither agrees nor disagrees with this statement. Figure 2-3 was drawn using best professional judgment.*

2.3.1.1 Page 2-12: It is not clear as to why analytical results for PCE from SMC-01 were not included in the discussion relating the extent of PCE on-site and off-site. There appears to be pervasive PCE contamination in the northwest corner of the site, which is updip, and upgradient of the well HN-52 cluster. This is corroborated by data from the December 1997 sampling event whereby HN-55S had 420 ppb PCE and HN-55I had 160 ppb PCE. (These wells have not been sampled since the December round). Additionally, it could be noted that there is an upward gradient in HN-52I such that contamination

in the intermediate zone could manifest itself in the shallow water bearing zones. It seems that additional sampling needs to be focused in this area to delineate the extent of both on-site and off-site PCE. ***Response:*** *The December 1997 sample from well HN-52S (not HN-55S) contained 420 ug/l of PCE. Sample HN-55S did not contain PCE. An upward gradient is not apparent at on-base well cluster HN-55, but is apparent at off-base well cluster HN-52.*

Among the samples from shallow monitoring wells near the northwest corner of the base, PCE was not detected in wells MW-03, HN-11X, HN-14S, HN-55S, and HN-59S above 3 ug/l. Note that intermediate well sample HN-52I revealed PCE at 12 ug/l, compared to 420 ug/l for shallow well sample HN-52S. The intermediate water-bearing zone at cluster HN-52 may be providing some recharge to the shallow zone; based on water level data, however, the PCE in well sample HN-52S is not from the intermediate zone, based on the much higher concentration in the shallow well versus the intermediate well.

Regardless, the Navy acknowledges that an on-base source of groundwater PCE contamination likely exists in the northwest portion of the base. However, it is hypothesized that another potential source (or sources) of PCE contamination may be present in the vicinity of well cluster HN-52. The Navy plans to sample the wells of interest (including well cluster HN-52) during future groundwater monitoring activities.

Page 2-14: It is well accepted that the degradation of PCE and TCE can successfully occur with the frequent generation of the chemicals listed here (including vinyl chloride). This discussion should be rewritten to reflect current scientific beliefs. ***Response:*** *The Summary Report was not intended to represent the full contents of an RI report and provide a detailed discussion of contaminant fate and transport for chlorinated hydrocarbons. This type of discussion will be included as part of any future RI report for Area A or Area D groundwater, if necessary.*

Section 2.3.3: 460 ppb TCE does not seem to be a "relatively low level of VOC". ***Response:*** *Only two of the 14 deep monitoring well samples from Area A showed VOCs greater than MCLs. The Navy recognizes that 460 ug/l of TCE is not a low level.*

Section 2.4.1.1: MW-E was reported in the other section to be in Area A. ***Response:*** *The report is incorrect. Well MW-E is indeed located in Area A. Among the Area D on-base shallow well samples, PCE concentrations ranged from non-detect to 4 ug/l. Samples from wells HN-56S and HN-58S1 contained PCE at 4 ug/l.*

Pennoni Comments (dated April 8, 1998)

The Area A and D report illustrates groundwater flow gradients for shallow, intermediate and deep wells. Because of the dip of the rock beds, a shallow well in the southern part of the site could be monitoring the same strata as an intermediate and deep well in the northern part of the site. A clearer representation of groundwater flow would be to show the flow gradient in a lithologic interval to reflect groundwater movement along the bedrock bedding planes. Such an illustration should also be provided for the interval with the highest contaminant concentration to better interpret the migration of contaminants. ***Response:*** *The Navy's understanding of the hydrogeology is consistent with these comments. The use of fence diagrams, cross sections, or other graphical displays to better portray the local hydrogeology and contaminant distribution will be considered as part of future RI or feasibility study (FS) reports for Area A and D groundwater, if necessary. The Summary Report was not intended to provide a detailed understanding of the site-specific hydrogeology associated with Areas A and D.*

The report states that the tetrachloroethene (PCE) concentration of 91 micrograms per liter (ug/l) was left out of the isopleth delineation in Plate 2 for the sake of clarity. No technical explanation was provided for ignoring this result. ***Response:*** *Additional isopleths representing concentrations of 10 and 50 ug/l for PCE were not drawn around well SMC-01 because they would have cluttered Plate 2 and obscured other information for that plate. The result was not ignored; it was specifically discussed in the report.*

The report also states that it was unlikely that the PCE concentration of 420 ug/l found in off-base Well HN-52S was related to PCE concentrations at the base because no significant concentrations were found between the base and the well. However the PCE found in the well could be the result of contaminant migration from a release that occurred previous to the source of the on-base plume. It cannot be assumed that the off-site plume originated off-site based on the information provided. ***Response:*** *The Navy acknowledges that an on-base source of groundwater PCE contamination exists in the northwest portion of the base. However, it is hypothesized that another potential source (or sources) of PCE contamination may be present in the vicinity of well cluster HN-52 due to both the PCE concentration and to the other contaminants and concentrations present in samples from this well cluster. The overall consistent levels of contaminants contained in samples from well HN-52S during 3 years of monitoring suggest a continuing source rather than a "slug" of contamination from a historic release. The Navy plans to sample the "wells of interest" as well as well cluster HN-52 during future groundwater monitoring activities.*

At this time, the regulatory agencies [specifically the United States Environmental Protection Agency (EPA) and the Pennsylvania Department of Environmental Protection (PADEP)] are reviewing information

provided by the Navy to identify and if necessary, further investigate potential off-base sources of groundwater contamination. The results of these investigations will help determine the need for any additional groundwater studies to be performed by the Navy in the vicinity of Area A.

In order to better evaluate the nature and extent of the contaminant plumes, the isopleths and plume delineation should be shown along the same lithologic interval or in cross-section. This would be preferable to illustrating the plumes in shallow and intermediate zones, which do not take into account the structural profile of the bedrock. **Response:** *The use of fence diagrams, cross sections, or other graphical displays to better portray the local hydrogeology and contaminant distribution will be considered as part of future RI or feasibility study (FS) reports for Area A and D groundwater, if necessary. The Summary Report was not intended to provide a detailed understanding of the site-specific hydrogeology associated with Areas A and D.*

The report suggests that 1,1,1-trichloroethane (1,1,1 -TCA) concentrations detected off base may not be attributable to the Navy, since upgradient wells did not have detections. This does not preclude the possibility that the plume has moved off base from a previous release. ***Response:*** *The Navy believes that an off-base source (or sources) of 1,1,1-TCA contamination may be responsible for the pattern of 1,1,1-TCA contamination detected in the vicinity of well sample HN-52S. From the distribution of 1 1,1-TCA and the associated chemicals, 1,1-DCA and 1,1-DCE, found predominantly in samples HN-16S, HN-52S, and Well No. 93, it appears that an off-base source for these contaminants is probable. EPA has acknowledged this probability.*

Well BK-1059 sampling results show detection of contaminants to the northwest of the pumping Warminster Authority Well No.26. This raises the possibility that contaminants may have migrated beyond the capture zone of Well No.26. Additional monitoring wells to the north and west of Well No.26 would be required to verify the effectiveness of the Well No.26 capture zone. ***Response:*** *The contaminant concentrations contained in sample BK-1059 did not exceed Maximum Contaminant Levels (MCLs). The Navy is not convinced these levels are reasonably attributable to NAWC Warminster.*

With regard to Area A, the Navy continues to evaluate the need for additional Area A hydrogeologic investigations, including the installation of new monitoring wells. Access problems associated with off-base properties have impeded the installation of off-base monitoring wells downgradient of the on-base portion of Area A.

Earth Data Comments (dated June 12, 1998)

What are the expected start and completion dates for the remainder of the OU-1 interim remedy components? ***Response:*** *The Navy plans to begin constructing the remainder of the OU-1 interim remedy in December 1998. Work is expected to last about 6 months.*

The USGS should be referenced with respect to the base supply well study. ***Response:*** *Any final RI reports for Area A or Area D groundwater will reference the appropriate USGS reports as necessary.*

What are the expected start and completion dates for the OU-4 interim remedy components? ***Response:*** *The Navy began construction of the OU-4 interim remedy in October 1998. Work is expected to last about 6 months.*

Preparation of final RI and FS reports for Areas A and D groundwater on an as needed basis suggests the interim remedies could become final remedies? ***Response:*** *The interim remedies could possibly become final remedies, particularly in terms of any additional construction. However, any final remedies will be supported by appropriate documentation, such as a Record of Decision (ROD) or Explanation of Significant Differences (ESD). The interim remedies do not specify clean-up goals for contaminated groundwater; the final remedies will.*

What determined placement of the dashed Areas A and D separation line? Water quality results for wells HN-17, HN-82 and HN-83? ***Response:*** *The separation line was drawn based on the presence of potential sources west of Jacksonville Road and to divide the report into separate discussions of each area. The water quality results for these wells were also considered. It is acknowledged that there may be some overlap between Area D and Area A groundwater contamination.*

The use of clustered, variable depthed wells is appropriate for the Stockton Formation. Intermediate and deep well open intervals are two to three times too long and have most likely lead to mixing of multiple water bearing (and losing) zones, which resulted in diluted chemical concentration data and average hydraulic head data, especially in the deep wells where open intervals are longest and hydraulic pressures are highest. Though the wells provide useable aquifer data to infer contaminant fate and transport, well construction biases well data. ***Response:*** *The well depths and screened intervals were determined based on procedures established with input from the Technical Subgroup Committee (TSC). Discrete zones are typically monitored, and the depth selection is based on drilling and borehole geophysical log information.*

With respect to Area A and D water levels, the report indicated bedrock dip was considered along with monitored intervals for potentiometric map construction. In addition, the report indicated the potential hydraulic control induced by pumping effects of a nearby municipal water-supply well. Potentiometric maps (Figures 2-1, 2-2, 2-3 and 2-4) in the report indicate only monitored intervals (shallow, intermediate etc.) were ultimately used to map and infer groundwater flow. ***Response:*** *The figures provide reasonable interpretations of generalized groundwater flow for the monitored intervals. If necessary, more sophisticated methods and evaluations will be used to construct additional potentiometric surface maps as part of future RI reports for Area A and D groundwater. The maps do not indicate a separation based solely on well designations. For example, wells HN-17S and HN-18S were not used for the shallow potentiometric surface map due to their depths. Well HN-17S was used for the intermediate depth flow map, and wells HN-15I, HN-17I, and HN-65I2 were used for the deeper groundwater flow map.*

- Review of the investigation data indicate three regional controls on groundwater flow: structure, topography and well WMA 26, with possible local influences from the base supply wells. The coincident alignment of the direction of dip of the leaky, multi-bed strata of the Stockton Formation (and associated bedding plane partings and interbed fracturing), the direction of topographic slope and the location of well WMA 26, all in a northward trend relative to Areas A and D, promote down dip recharge and off-site flow of groundwater out of Areas A and D towards the north. ***Response:*** *None required.*

- Under natural conditions, the combined effect of the topographic slope essentially parallel to the direction of the dipping multi-layered units, promotes infiltrated recharge to be driven down dip, resulting in the confinement of groundwater at depth under successively deeper layers of beds. As a result, groundwater at depth will appear "confined" from more shallow overlying groundwater, however shallow groundwater anywhere in the area will eventually "recharge" deeper, more laterally distant down dip fracture zones. Superimposed on this natural system is the continuous pumping effects of WMA 26. The deep, open rock construction and high yield of the well acts to significantly lower hydraulic heads in the surrounding strata, including fractures that dip towards the well from the south (Areas A and D), steepening gradients and further promoting down dip flow from south to north. ***Response:*** *None required.*

- Though cross bed leakage does occur, up or down, depicting horizontal groundwater flow through shallow, intermediate and deep "zones" of the aquifer implies groundwater in any one zone traverses the entire zone, as currently mapped from south to north, as though each zone were isolated from another. Shallow groundwater occurring at any one time in the vicinity of HN-32(S) most likely does not entirely flow to HN-52(S), but rather recharges deeper fractures down dip,

especially under exaggerated pumping gradients. ***Response:*** *None required*

- In light of the above, evaluation and discussion of Area A and D groundwater levels and contaminant distribution should be refined to conform with aquifer hydrogeology and the known controls on groundwater flow and not arbitrary, categorical "levels" or "zones" like shallow, intermediate and deep. Discussion of these levels is appropriate at a given well cluster, in light of the monitored intervals relative to the supposed depth of the viable aquifer, but not in the context of regional groundwater flow. ***Response:*** *To meet the objectives of comprehensive Area A and Area D groundwater monitoring, the Navy believes it is reasonable in the Summary Report to discuss groundwater flow and contaminant distribution according to shallow, intermediate, and deeper water-bearing zones. The Summary Report was not intended to represent the full contents of an RI report and provide a detailed understanding of the site-specific hydrogeology associated with Areas A and D. More in-depth evaluation will be performed as part of any future RI reports. Information relevant to a specific well cluster and the monitoring wells associated with that cluster are contained in the appendices to the report.*

- The average yield and pumping water level within WMA 26 for the period of monitoring well water level measurement should be included in the aquifer water-level discussion. ***Response:*** *This information was available from the Warminster Municipal Authority but was not presented in the Summary Report. During water-level measurements, the average yield of WMA 26 was 299 gallons per minute. A total of 323,000 gallons were pumped from WMA 26 over a 18-hour period on December 3, 1997. The average pumping water level was 196 feet below the ground surface on this same day.*

- Cross sections or fence diagrams, at least one per area, oriented parallel to dip through the principal axis of TCE or total VOC contamination and well WMA 26, should be constructed showing both topographic slope and underlying structure to better visualize the aquifer and determine stratigraphic zones to map groundwater through. Local strike and dip measurements should be used. The middle member of the Stockton Formation is known for thick sandstone units relative to thinner shale-siltstone units. Well density in the areas is sufficient to attempt to correlate and trace the coarser grained units for depiction on the cross sections/fence diagrams, again in an attempt to identify area specific hydrostratigraphic zones suitable for potentiometric surface mapping. The sandstone unit correlation would be useful to at least establish an aquifer framework for both understanding contaminant flow and more importantly, for the adequate design and implementation of interim or long-term contaminant recovery systems. ***Response:*** *The interim extraction well network was designed by the Navy in 1994 and will be installed*

beginning in December 1998. The Summary Report provides additional information that was taken into consideration when reviewing the 19994 design. Based on this review, no significant changes to the recovery system are contemplated at this time.

The use of fence diagrams, cross sections, or other graphical displays to better portray the local hydrogeology and contaminant distribution will be considered as part of future RI or feasibility study (FS) reports for Area A and D groundwater, if necessary. The Navy is also considering the preparation of a technical impracticability (TI) evaluation for restoring contaminated Area A groundwater. This evaluation will rely on all of the available information regarding Area A groundwater, site-specific hydrogeology, and the performance of the interim Area A groundwater remedy. The Summary Report was not intended to provide a detailed understanding of the site-specific hydrogeology associated with Areas A and D.

- An attempt should be made to construct water level maps from combinations of shallow, intermediate and deep wells that are open and therefore potentially monitor the same bedding plane/hydrostratigraphic zones between Area D, Area A and WMA 26. At least two potentiometric maps, one originating at well HN-32 (S) for Area D and one originating at well HN-11 (I) for Area A [or more specifically a shallow well located up dip from HN-11 (I) coincident to the same bedding plane/stratigraphic zone monitored by HN-11 (I), maybe HN-12 (S)?] should be constructed in this manner to show the relationship between horizontal groundwater flow and structure. ***Response:*** *These types of maps were considered to be beyond the scope of the Summary Report. The use of fence diagrams, cross sections, or other graphical displays to better portray the local hydrogeology and contaminant distribution will be considered as part of future RI reports for Area A and D groundwater, if necessary.*

- The discussion of "positive hydraulic head differentials" at individual well clusters would have more meaning in the context of structure and stratigraphy than from "deep to shallow water-bearing zones," and may be irrelevant to regional groundwater flow other than to demonstrate the degree of confinement or really the degree of hydraulic disconnection of shallow groundwater from immediately deeper underlying groundwater. ***Response:*** *To meet the limited objectives of comprehensive Area A and Area D groundwater monitoring, the Navy believes it is reasonable in the Summary Report to discuss hydraulic head differentials according to shallow, intermediate, and deeper water-bearing zones. The Summary Report was not intended to provide a detailed understanding of the site-specific hydrogeology associated with Areas A and D. The draft Focused RI for Groundwater Report for NAWC Warminster (Halliburton NUS, July 1995) provides detailed information regarding Area A and Area D hydrogeology. This type of discussion will be*

included as part of any future RI reports for Area A or Area D groundwater, if necessary.

Groundwater flows from shallower to deeper zones down dip and may leak across and around beds at depth as a result of higher hydraulic pressure and the known inability of the lenticular beds that make up the formation to completely confine or disconnect water bearing zones. ***Response:*** *The Navy acknowledges these comments; no additional responses are required. Note, however, the general absence of groundwater contamination at depths greater than 200 to 250 feet below the ground surface.*

Discussion of groundwater quality relative to shallow, intermediate and deep zones in Area A (and Area D) does not correlate with actual groundwater flow through Area A and offsite. Area A contaminant fate and transport would be better described in the context of structure and stratigraphy, with or without the influence of well WMA 26, beginning with where contaminants are most prevalent and proceeding off site, down gradient and down dip to the north. Discussion of the entire plume as it has dispersed down through the aquifer makes more sense than discussion within out-of-context categories. The cross sections/fence diagrams would greatly improve groundwater quality discussion. This same comment applies to Area D. ***Response:*** *The Navy believes that groundwater sample results from on-base shallow and intermediate monitoring wells can be presented as done in the report and can be used by reviewers for making comparisons regarding off-base groundwater quality for these water-bearing zones.*

The use of fence diagrams, cross sections, or other graphical displays to better portray the local hydrogeology and contaminant distribution will be considered as part of future RI or feasibility study (FS) reports for Area A and D groundwater, if necessary. The Summary Report was not intended to provide a detailed understanding of the site-specific hydrogeology associated with Areas A and D.

Characterization of Area A (and Area D) contaminant impact to off site groundwater appears incomplete. The most down gradient well clusters installed for the study have not delineated the extent of the plume. The only inference that can be made is that all of the contaminants are drawn to WMA 26. This comment applies to Area D. ***Response:*** *With regard to Area A, the Navy continues to evaluate the need for additional Area A hydrogeologic investigations, including the installation of new monitoring wells. Access problems associated with off-base properties have impeded the installation of off-base monitoring wells downgradient of the on-base portion of Area A. However, the Navy points out that it may not be necessary to fully delineate the extent of contaminated Area A groundwater in order to select and implement appropriate interim or final clean-up plans*

Concerning Area D, the Navy disagrees that the pattern of significant Area D groundwater contamination has not been adequately delineated. Monitoring wells downgradient of Area D have not revealed the

presence of VOCs at elevated levels.

The report summary and conclusions should be revised as needed following revision of the approach to characterize groundwater flow and contaminant dispersion consistent with aquifer geology and hydraulics. ***Response:*** *The Navy believes that the conclusions presented in the Summary Report are reasonably valid and do not require any necessary revisions to meet the objectives of this report.*

An additional well cluster, appropriately constructed, should be installed in the vicinity of Building 70 in Area D where the wastewater lines were found to be badly damaged. Three additional well clusters, appropriately constructed, should be installed down dip from existing clusters HN-50, HN-16 and HN-52, but updip from WMA 26. ***Response:*** *The Navy does not plan to install a well cluster near Building 70. Two well clusters (HN-17 and HN-19) are already present downgradient of the location where wastewater lines were damaged. Once operational, the Area D extraction wells located between Building 70 and the main building complex (Buildings 1 and 2) will minimize further off-base migration of contaminated Area D groundwater. As such, there is no need for additional wells near Building 70.*

The Navy continues to evaluate the need for additional Area A hydrogeologic investigations, including the installation of new monitoring wells. Access problems associated with off-base properties have impeded the installation of off-base monitoring wells downgradient of the on-base portion of Area A. However, the Navy points out that it may not be necessary to fully delineate the extent of contaminated Area A groundwater in order to select and implement appropriate interim or final clean-up plans.

Area A and D groundwater quality discussion should incorporate the results of the USGS testing at the base supply wells in the area. ***Response:*** *Any final RI reports for Area A or Area D groundwater will reference the appropriate USGS reports.*

Lastly, groundwater quality discussions should incorporate discussion on chlorinated hydrocarbon transformation, both current and potential future transformation, as this will impact groundwater recovery in the future. ***Response:*** *The Summary Report was not intended to represent the full contents of an RI report and provide a detailed discussion of contaminant fate and transport for chlorinated hydrocarbons. This type of discussion will be included as part of any future RI reports for Area A or Area D groundwater, if necessary.*

In summary, investigation of Area A and D groundwater contamination, where investigated, has been extensive. Based on other hydrogeologic investigations in this formation, considerable data exist to develop a very detailed understanding of groundwater flow and contaminant dispersion in the area and

for the formation in general. The Area A impact to off site groundwater quality characterization should be finished through additional well installation, or it should be acknowledged with existing data that the contamination detected in well clusters HN-50, HN-16 and HN-52 is ultimately drawn towards WMA 26. ***Response:*** *With regard to Area A, the Navy continues to evaluate the need for additional Area A hydrogeologic investigations, including the installation of new monitoring wells. Access problems associated with off-base properties have impeded the installation of off-base monitoring wells downgradient of the on-base portion of Area A. However, the Navy points out that it may not be necessary to fully delineate the extent of contaminated Area A groundwater in order to select and implement appropriate interim or final clean-up plans.*

Abandon use of the shallow, intermediate and deep "categorization" of the Area A and D aquifers and replace categorization with "hydrostratigraphic characterization" based on the voluminous amount of data on actual topography, geology, structure, and groundwater flow and contaminant dispersion. This will improve interim and long-term groundwater recovery efforts by providing for more accurate recovery well location, construction and operation. ***Response:*** *The Navy does not currently plan to abandon the use of shallow, intermediate, and deeper water-bearing zones associated with underlying aquifers to describe the nature and extent of groundwater contamination attributable to NAWC Warminster. Any future RI reports for Areas A and D groundwater, if necessary, will provide a more detailed hydrogeologic characterization than was presented in the Summary Report, which will not be limited to depth interval comparisons.*

ENCLOSURE 2

RESPONSES TO COMMENTS
SUMMARY REPORT FOR 10TH ROUND OF PERIMETER MONITORING
December 31, 1998

EPA Region III Comments (dated October 14, 1998)

The report suggests that off-site sources of contamination are responsible for the pattern of 1,1,1-TCA found in the vicinity of Area A and PCE in the vicinity of the shallow well HN-52S. From the distribution of 1 1,1-TCA and the associated chemicals, 1,1-DCA and 1,1-DCE, found predominantly in shallow wells HN-16 (not well cluster HN-66 as stated on page 2-35) and HN-52 and Well No. 93, it appears that an off-site source for these contaminants is probable. ***Response:*** *None required.*

However, it is not clear that the source of PCE in HN-52S is off-base. The discussion in the perimeter report on page 2-35 regarding PCE concentrations found to date and the statement that the "maximum PCE concentration (3,200 ug/l) was found in off-base well HN-52S at a level six times higher than any previous round of perimeter sampling" is somewhat misleading as it only considers data collected during the perimeter sampling rounds. It does not include data collected during other sampling events and does not recognize that during the sampling round in which the 3,200 ug/l of PCE was found, the upgradient on-site wells (SMC-1, HN-55) and HN-59 (close to the site) were not sampled. Additionally, according to the data tables in the report both HN-52S and on-site well HN-55S had 420 ug/l PCE during the previous December 1997 sampling round. ***Response:*** *Based on Navy studies, the PCE concentration of 3,200 ug/l in well sample HN-52S is the highest level ever detected for this compound in the vicinity of Area A, including sampling events other than perimeter monitoring. The previous highest PCE level in samples collected from HN-52S was 500 ug/l (March 1997). The statement is not intended to be misleading. The highest on-base PCE concentration found to date is 350 ug/l, as noted in sample HN-12S/BG-4 (May 1992). The highest PCE levels in samples from SMC-01 (160 ug/l - September 1994), HN-59S (1 ug/l - December 1997), and HN-59I (130J ug/l - December 1997) are generally at least one order of magnitude less than the Round 10 perimeter monitoring result for sample HN-52S. The data table in the Round 10 report is incorrect for well HN-55S, since PCE was not detected in this well sample during December 1997.*

Furthermore, an analysis of the data indicates that wells HN-11I, HN-14I, HN-59I, HN-55I and SMC-01 have the same signature regarding four chemicals (PCE, TCE, carbon tetrachloride and chloroform) in the same relative proportions. In all wells, lower concentration levels of TCE, chloroform and carbon

tetrachloride are present in comparison to levels in HN-11I and with the exception of HN-14I, all wells have higher PCE levels compared to HN-11I. It seems likely that an on-site source of PCE contamination, separate from that of the TCE, carbon tetrachloride and chloroform, exists in the northwest portion of the site. Unfortunately, the wells of interest (HN-14, -55, -59, and SMC-01) were not sampled in the latest July 98 round when PCE and TCE levels in HN-52S and HN-52I increased. ***Response:*** *The Navy acknowledges that an on-base source of groundwater PCE contamination likely exists in the northwest portion of the base. However, it is hypothesized that another potential source (or sources) of PCE contamination may be present in the vicinity of well cluster HN-52. The Navy plans to sample the "wells of interest" as well as well cluster HN-52 during future groundwater monitoring activities.*

TCE concentrations also increased in HN-15S in this latest round. It would be most helpful to see if any on-site activities in Area A could be correlated to these contaminant concentration increases. ***Response:*** *The Navy is not aware of any on-site activities that occurred immediately before or during the perimeter monitoring field work.*

It is clear that to appropriately determine if an off-base source does exist which would contribute to the PCE contamination found in HN-52 and to gain a better understanding of the extent of the contamination emanating from the base, further work is warranted. At a minimum, several rounds of synoptic well sampling and analysis in this part of Area A are recommended. ***Response:*** *The sampling plan for Round 11 perimeter monitoring will include wells HN-14I, HN-55I, HN-59I, and SMC-01. In addition, these same wells will be sampled during pre-startup, startup, and short-term Area A performance groundwater monitoring.*

Section 2.2: This section reports that a full round of groundwater monitoring for Area B was performed in June 1998 and the report will be available in October. A letter report dated July 27, 1998 summarized the data from seven new monitoring wells in the Navy Enlisted Housing Area and during the subsequent TSC meeting I raised my concerns about the use of the "slow purge and sample technique" which were the same as those provided to you in my memo regarding the Summary Report for Areas A and D. Additionally, groundwater levels from the new wells were not available for the letter report; they should be included in the forthcoming comprehensive report. Thus, any comments regarding contamination in Area B will be provided pursuant to receiving the new report. ***Response:*** *No response is required.*